THE EXPLOSIVES ENGINEER

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Forerunner of Progress in Mining, Quarrying, Construction

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Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.

The search for new reserves of natural gas is going on at an intensive pace. A substantial volume of natural gas is drawn from the brown shale of the Devonian system in West Virginia and bordering states. Ninety per cent or more of the wells drilled into this brown shale have been economically productive only after being shot with explosives of high strengths and high rates of detonation.

Some of the important work details involved in extending a gas well in Lincoln County, West Virginia, to a depth of 3,453 ft. are presented in the article by W. C. Burkle, beginning on page 38.

* * *

The Blue Creek coal basin in Alabama, an area about 6 miles long and 2 miles wide located 10 miles southwest of Bessemer, has been producing coal almost continuously since 1886. In that year, DeBardeleben Coal & Iron Company started mining operations in the Adger, Johns, and Sumter slopes. These activities continued until 1892, when DeBardeleben sold its interest to The Tennessee Coal, Iron and Railroad Company. TCI continued mining operations until 1919. Six years later, TCI leased the three slopes to Black Diamond Coal Mining Company.

Today, using the room-and-pillar method of mining in virgin coal 2 miles square, Black Diamond is producing high-grade coking coal from three slope mines.

Please turn to page 43 for a description of the operating procedures in Alabama's Blue Creek basin.

* * *

The demolition of two towering smokestacks at the Williamsport plant of Pennsylvania Power and Light Company posed several difficult problems. After careful examinations and consultations, the power company, the contractor, and representatives of Hercules Powder Company decided to bring down the stacks by blasting with explosives.

A brief summary of what was done to get the desired results may be found on page 48.

* * *

At the annual meeting of the National Crushed Stone Association in Miami Beach, Florida, January 15 through 17, Warner Company's Bell Mine, Bellefonte, Pennsylvania, was awarded a plaque, donated by The Explosives Engineer, for the best safety record among 73 competing quarries during 1955.

Twenty-nine other member operations were awarded engrossed Certificates of Honorable Mention for accident-free records during the year. The recipients of the certificates are listed on page 52.

* * *

Basalt, a dense igneous rock, is widely used for construction work in the Hawaiian Islands. One of the better-known basalt quarries in the Hawaiian group is at Kaena Point on the western tip of Oahu. Current activities are confined to one high point of rock which juts out of a precipitous range of hills.

The article beginning on page 53 describes the economical and efficient use of the tunnel method of blasting the basalt in the quarry face, which rises 350 ft. above the floor at its highest point.

* * *

An unusual example of controlled blasting in a confined space under difficult conditions is presented in "Blasting Rock Under a City Dwelling" on page 59.

EDITORIAL STAFF: JOSEPH I. HORTY, *Editor;* GERTRUDE A. DONNELLY, *Assistant Editor;* JAMES J. O'NEILL, *Associate Editor;* EDWARD L. GRANT, *Art Editor;* FRANK J. CANOVA, *Production Manager;* CHARLES E. RABENOLD, *Advertising Manager;* MONTGOMERY R. BUDD, *Director.*

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BPA

VOL. 35 NO. 2 MARCH-APRIL, 1957

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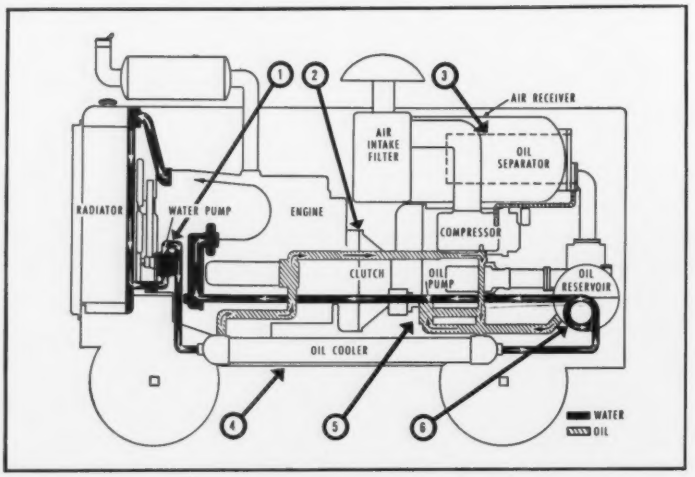

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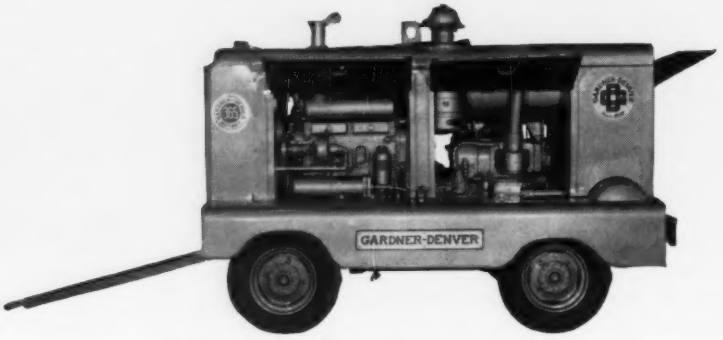

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HERCULES

Grover J. Holt

PRESIDENT, AMERICAN INSTITUTE OF MINING,
METALLURGICAL AND PETROLEUM ENGINEERS

A Biography

THE election of Grover J. Holt to the presidency of the American Institute of Mining, Metallurgical and Petroleum Engineers for 1957 is a fitting climax to years of active and useful service in that organization. His familiarity with Institute affairs and his recognized technical knowledge and experience presage a successful administration.

Grover, as his friends and associates know him, was born in Northwood, North Dakota, July 30, 1894, the son of Andrew B. and Mattie (Hagen) Holt. After completing his elementary education in the local public school and the high school at Hope, North Dakota, Grover went to the University of North Dakota and was graduated in 1916 with a B.S. degree in mining engineering and in 1941 was given the degree of Engineer of Mines. During high school years and at the University, he played basketball and baseball.

Following his graduation from the University of North Dakota, Grover received a fellowship from the United States Bureau of Mines to do postgraduate work in metallurgy and ore dressing at the University of Utah, and last year was awarded an honorary degree of "Doctor of Engineering" by Michigan College of Mining and Technology.

Soon after leaving the University of Utah, he accepted a position with Basin Metals Mining Corporation as superintendent of construction at its copper-leaching plant in Ouray, Utah.

During World War I, Grover enlisted in the U. S. Army, Corps of Engineers, and was assigned to officers' training school at Camp Humphrey, Virginia. Upon receiving his commission, he was sent to France for officer duty with the Corps of Engineers.

With the termination of the war, he was returned to the United States and went to work for Bunker Hill & Sullivan Mining and Concentrating Company at Kellogg, Idaho. Two years later he joined the United States Steel Corporation at Chisholm, Minnesota, as a mining engineer. He remained in that post until 1928 when he left to become chief engineer and superintendent of Manganiferous Iron Company at Crosby, Minnesota. In 1930, he left Manganiferous to become assistant to the vice president of Butler Brothers in St. Paul.

While with Butler Brothers, Grover worked on the development of the ferro-silicon sink float process, which is now in use by various companies in 150 plants, separating everything from iron ore to diamonds.

In 1942, Grover began his association with The Cleveland-Cliffs Iron Company as chief engineer. Eight years later, he was made manager of the company's mines in Minnesota. In 1953, he was moved up to general manager of its ore-mining operations in both Minnesota and Michigan, the position he holds today.

Grover was associated with the early development of heavy trucking and conveyor belts out of open-pit mines on the Mesabi Range in Minnesota. He made significant contributions to the block-caving method of extracting iron ore on the Michigan Ranges and in the development of high-grade pellet production from jaspers.

For many years, Grover Holt has been an active member of the American Institute of Mining, Metallurgical and Petroleum Engineers. He helped in forming its Minerals Beneficiation Division and, at one time, served as the chairman of this division. In 1953, he was chairman of the annual fall meeting of this division held at Hibbing, Minnesota. He has been chairman of the Minnesota Local Section of the AIME. He has served on the Institute's Nominating Committee and in 1954 he was its chairman. Following his nomination for the presidency of AIME for 1957, he was elected and took office at the annual meeting of the Institute in New Orleans on February 27.

In addition to his activities in AIME, Grover is a member of the Mining & Metallurgical Society of America; the Engineers Club of Northern Minnesota; the Marquette Range Engineers Club; and the Kitchi Gammi Club in Duluth.

Grover J. Holt married Grace Ueland on June 7, 1921, in Roseburg, Oregon. They have two daughters: Mrs. Corinne M. Rickert and Mrs. Madeline M. Campillo. The Holt family home is at 214 Jasper Street, Ishpeming, Michigan.

Like most successful businessmen, his principal hobby is his work. But when opportunity permits, Grover enjoys fishing and hunting with his friends, and in matching strokes with them on nearby golf courses.

GROVER J. HOLT

DETONATION OF 6,733 LB. OF 80% OIL WELL GELATIN
IN A WEST VIRGINIA GAS WELL.

Shooting A Deep Gas Well With Explosives

The fracturing of the Devonian shale formations in Lincoln County, West Virginia, with a charge of 80% Oil Well gelatin increased the flow of natural gas to 810,000 cu. ft.

W. C. BURKLE*

Our expanding economy demands ever-increasing supplies of fuels for industrial and domestic uses. High on this list for more fuels is natural gas, which has attained a position of major importance as an energy source. The search for new reserves of natural gas is being conducted at an intensive pace.

A substantial volume of natural gas is drawn from the brown shale of the Devonian system in West Virginia and bordering states. Ninety per cent or more of wells drilled into this brown shale have been economically productive only after being shot with explosives of high strengths and high rates of detonation. The shale is fractured by shooting from 300 to 1,000 ft. of hole with these types of explosives, which permits the gas to migrate under pressure to the wells.

Some authorities believe that the brown shale is both the source and the reservoir bed of natural gas. Others are of the opinion that lenselike stratigraphic traps, in which the shale is more porous because of the presence of sand, are responsible for the accumulation of this important fuel. Another theory holds that the gas moves, for the most part, laterally along countless laminations. Consequently, when these natural partings are shattered or disturbed for a distance, the increased permeability of the formation permits a greater flow of gas to the well.

On November 17, 1955, officials of United Fuel Gas Company of Charleston, West Virginia, awarded a contract to R. H. Adkins of Hamlin, West Virginia, to drill a well in the Harts Creek District of Lincoln County, West Virginia. The project was designated Well No. 8160. Within a few weeks, the contractor built a roadway to the location. Bad weather conditions caused some delays in getting the job under way. However, drilling operations were started in January, 1956.

When the well had been drilled to a depth of 1,544 ft., gas was encountered in the Big Lime formation. The flow of gas tested 133,000 cu. ft. At a depth of 1,565 ft., the flow increased to 365,000 cu. ft. As the drilling progressed into the Injun Sand, the flow of gas at 1,632 ft. increased to 377,000 cu. ft.

Treating the Formations With Hydrochloric Acid

While the drilling was in progress, samples of the Big Lime formation

*Hercules Powder Company
Wilmington 99, Delaware

SITE OF NEW WELL: Drilling operations for the sinking of Well No. 8160 were conducted at the site shown at left. The powder truck and the torpedoes are located in the background.

PREPARING THE CHARGES: Employes of King Torpedo Company begin the loading of charges of 80% Oil Well gelatin packed in 4 by 16-in. cartridges into tapered-end tin shells 10½ ft. long, called torpedoes.

were taken and sent to the Geological Department of United Fuel Gas Company at Charleston for analyses. In due course, the geologists, under the direction of J. L. Hutchinson, chief geologist, reported that the analyses determined that the formation could be acidized. Consequently, United Fuel treated the Big Lime formation with 1,500 gals. of standard hydrochloric acid. A short time later, the Injun Sand formation was fractured. Following the application of the treatments to these two formations, the well had a combined flow of 421,000 cu. ft. of gas. A string of 5½-in. casing was run and the gas was produced between the 5½-in. casing and the enclosing 7-in. casing. Drilling was then completed through the Devonian shale, using a 4⅞-in.-diameter bit.

Following the drilling of the shale, this formation was producing 51,000 cu. ft. of gas. Plans were adopted to shoot the formation in expectations of an increased flow. King Torpedo Company of Hamlin, West Virginia, was engaged to handle the explosives-loading and -shooting operations.

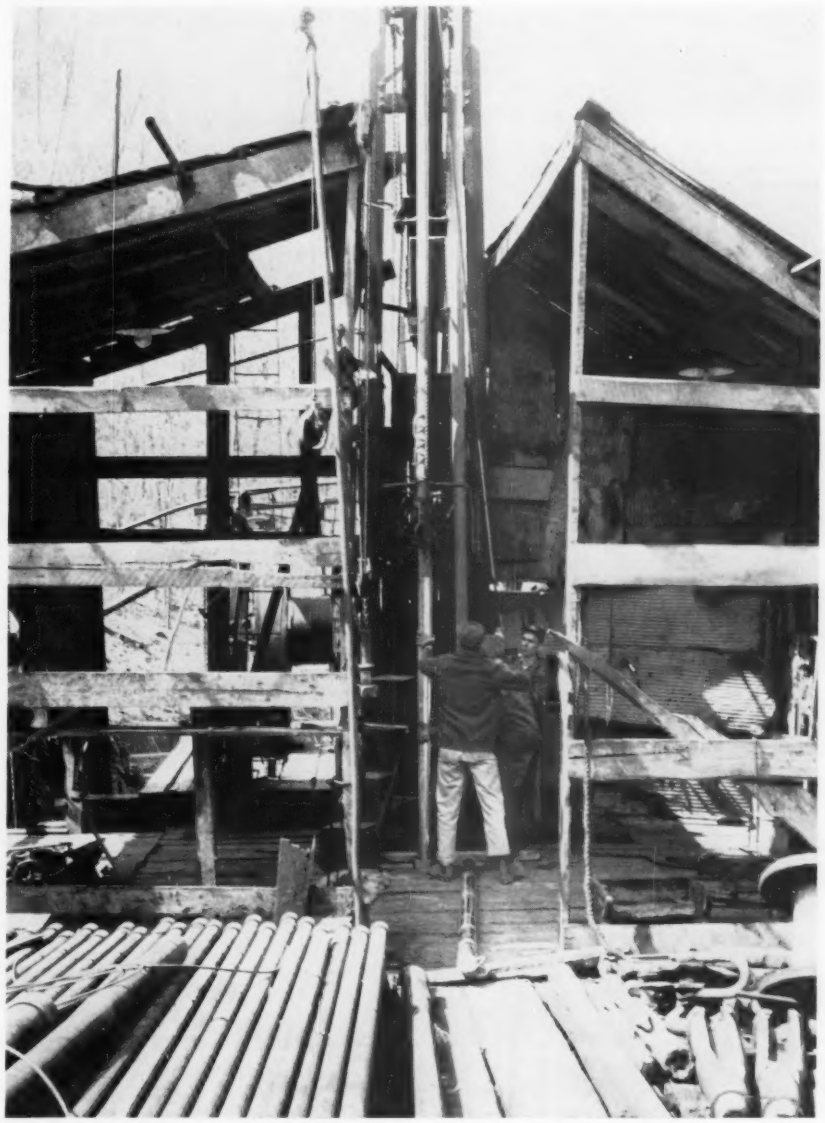
The driller's log noted a show of gas at 2,426 ft. in a formation referred to as "slate and shells." Underlying this formation is the Devonian shale. It was decided to shoot the well from the 2,423-ft. depth to the 3,453 ft., the latter figure being the bottom of the well. This meant that the total column of formation to be shot measured 1,030 ft.

Details of Blasting With 80% Oil Well Gelatin

Everyone concerned agreed to shoot the well with 80% Oil Well gelatin packed in 4 by 16-in. cartridges. King Torpedo Company manufactures tapered-end tin shells 10½ ft. long that hold eight of the 4 by 16-in. cartridges, representing a charge of 66⅔ lb. of the 80% gelatin. Two of these loaded shells, containing 133⅓ lb. of the gelatin, are hooked together and lowered into the well as one unit. Each lowering of this explosives-loaded unit is known as a "run."

Before the first run was made, the depth of the well was measured to make certain that no cave-in had occurred and that the well was the intended depth. This measurement was taken with a device called a depthometer. As the bailer was lowered into the well the bailer cable actuated gears which measured the length of cable passing through the depthometer. For lowering runs of explosives, the King company uses a 1,400-lb. test-stranded steel line. The reel on which this line is wound is powered by a Waukesha gasoline engine mounted on a Dodge power wagon.

On April 18, 1956, a charge of 6,733⅓ lb. of 80% Oil Well gelatin inside 104 tin shells was loaded into Well No. 8160 and shot. The loading of the explosives started at 9:30 a.m. and was completed at 2 p.m. Detonation of the explosives was accomplished by dropping a "Jack" squib down the well onto the loaded column of 80% gelatin. A Jack squib is a slender tin tube 7 to 8 ft. long with a tapered end. Usually, the tube is 2 in. in diameter. The Jack squib used by the King company on the above shot was loaded with six 1¼ by 8-in. cartridges of 60% Oil Well gelatin primed with two No. 6 blasting caps. Each blasting cap was fitted with a 5-ft. length of Clover brand white wax safety fuse. At approximately 2:30 p.m. the area was cleared and the shooter dropped the Jack squib down the well and detonated the charge. Sometimes a column of gelatin loaded



LOWERING A RUN: With the aid of a pulley secured on the drill stem, three men lower the torpedoes into the well. Each lowering is known as a "run."

MAKING A JACK SQUIB: Shooter H. B. Harman makes up a Jack squib to detonate the charges of 80% gelatin loaded into Well No. 8160. Each Jack squib is 7 to 8 ft. long.

in a well will be detonated on impact by the dropped squib. Therefore, the shooter always makes a hurried retreat from the rig floor after dropping a Jack squib.

Frequently, a time bomb is used to shoot a charge of explosives loaded into a well. When this device is employed, it usually accompanies the loading of the last run of explosives. At times, both a time bomb and a Jack squib are used to detonate a charge of explosives in a well. This is done to provide added assurance against a possible cave-in atop the gelatin.

Gas Flow Increased

Seven days after the well was shot and cleaned out the flow from the shale measured 389,000 cu. ft., a big increase over the 51,000 cu. ft. of flow prior to the shooting. The total flow of gas from the well, including the lime and sand production, measured 810,000 cu. ft.

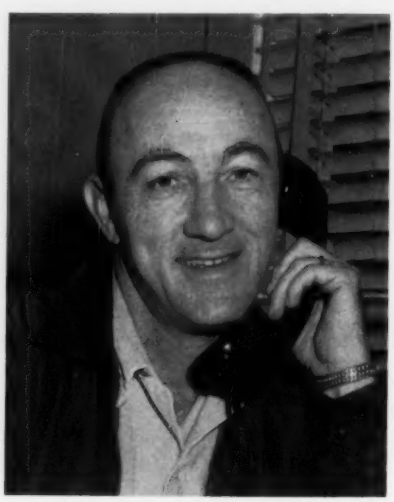
Once drilling operations are started on a gas well they continue around the clock each day except Sunday. Workmen sleep and prepare meals in a cabin nearby. Well No. 8160 was completed on April 12, 1956. Therefore, it required a little more than three months to drill 3,453 ft. of hole. The drilling was done with an Ideco drilling machine, a cable tool rig. Power was supplied by a 110-hp. gas engine made by Riese Engineering Company. Four bit sizes were used in the well, beginning with a 13-in. bit. In descending order, the reduced sizes of bits were 10, 8, 6, and 4¾ in. A full string of tools such as used on the Well No. 8160 project weighs in excess of 2,000 lb.

Operating Personnel

As previously indicated, the headquarters of United Fuel Gas Company are located in a new, ultramodern office building at 1700 MacCorkle Avenue in Charleston, West Virginia. John W. Partridge, president, and James S. Phillips, vice president and general manager, direct the activities of the organization. The company's field of operations is divided into three divisions. H. C. Mefford, Jr., superintendent of field, Production Department, exercises authority over the three divisions. Well No. 8160 was drilled in the area covered by the Central Division with offices in Branchland, West Virginia. The activities of the Central Division are under the direction of Walter Chapman, division superintendent of the Production Department. United Fuel's crews on the Well No. 8160 project were under the supervision of Edgar Roberts, field foreman. The shooters for King Torpedo Company, Hamlin, West Virginia, were H. B. Harman and G. B. Barett.

J. L. Hutchinson.

H. C. Mefford, Jr.



Walter Chapman.

Alabama's Black Diamond Coal Mining Company

A summary of underground operating procedures and the preparation of high-grade coking coal in the Blue Creek coal basin 10 miles southwest of Bessemer

D. V. PLAN*

THE BLUE CREEK coal basin in Alabama is a relatively small area, 6 miles long and 2 miles wide, located about 10 miles southwest of Bessemer. It is adjacent to, but not connected with, the south edge of the Warrior coal field. The first development of the basin area was the opening of mines in the north side in 1886 by Henry F. DeBardeleben, one of the pioneers in the Birmingham district. Since that time, coal mining operations in the Blue Creek basin have been continuous, with the exception of a comparatively short period in the early 1920's.

As indicated above, the first mining activity in the basin occurred in 1886 when DeBardeleben Coal & Iron Company opened the Adger, Johns, and Sumter slopes under the direction of Major R. H. Elliott. The slopes, comprising a large part of Blue Creek basin, were operated by the DeBardeleben company until 1892 when it sold the slopes and adjacent properties to The Tennessee Coal, Iron and Railroad Company, more familiarly referred to as TCI. The latter organization continued production until 1919 when it discontinued operations in the basin.

In 1925, TCI leased the flooded workings to Black Diamond Coal Mining Company, and mining operations were resumed immediately. After the work of dewatering was completed, the Black Diamond company, headed by C. S. Blair of Birmingham, started

MINE ROOF SUPPORT: The mine roof is supported by roof bolts which, with expansion shells, are 5½ ft. long. Holes for inserting the bolts are drilled into the roof by Joy SS-10 stopers in a definite pattern on 4-ft. centers.

*Hercules Powder Company
Birmingham, Alabama

CUTTING THE COAL: A Jeffrey 29-U rubber-mounted cutting machine is used to cut the top of the coal seam about 12 in. below the roof. The top cut extends across the full width of a room.

DRILLING BLAST HOLES: Drilling blast holes in the coal involves 12 to 14 holes, each 1½ in. in diameter and 9 ft. deep, on a 4 by 6-ft. spacing, using Jeffrey A-9A 9-ft. hydraulic drills equipped with Kennametal augers and bits, style D 1⅞.

LOADING EXPLOSIVES: Each hole is loaded with one 1¼ by 24-in. King-Size cartridge of Red H A permissible powder primed with a Hercules Electric Blasting Cap. After the explosives are loaded, the holes are tamped to their collars with rock dust.

mining in the three slopes by removing pillars. These pillar-removal activities were continued for approximately the next 20 years.

As mining progressed, officials of the Black Diamond company realized the need for additional coal reserves. Negotiations were completed and a contract signed with officials of TCI for the leasing of the remaining coal reserves in the Blue Creek basin, including a solid block of virgin coal approximately 2 miles square.

Mining Virgin Coal

At present, Black Diamond is mining the virgin coal in three slope mines: Black Diamond No. 1, originally opened in 1943; Black Diamond No. 2, opened in 1944; and No. 3 Slope Mine, where operations began during the early part of 1957. Production from the three mines is high-grade coking coal.

Mines No. 1 and No. 2 were developed by the room-and-pillar method of mining and hand loading. The slopes were driven approximately down the true dip, and headings were turned along the strike on either side of the slopes. The rooms were turned up the dip on 80-ft. centers in most cases. After blasting, the coal was loaded by hand on Jeffrey conveyors which discharged it into mine cars in the heading below.

Slope Mines No. 1 and No. 2 were mechanized in 1954 and all hand-loading work was eliminated. When No. 3 Slope Mine was opened early in 1957, it, of course, was planned for mechanical operation. No change in the original room-and-pillar mining method was found necessary because of the changeover to mechanization.

Where the three slope mines were opened in the Blue Creek basin, the coal seam dips 25 per cent at the southwestern outcrop. It gradually flattens out to level in the basin where the maximum thickness of the overburden is approximately 600 ft. The seam worked by Black Diamond is very soft and, in structure, is typical of rather low volatile coking coal. It varies from 6 ft. to 9 ft. thick, with several partings of soft shale ranging in thickness from ½ in. to about 10 in. As the three slopes penetrate the same coal seam and overall conditions are about the same, mining procedures in each slope do not

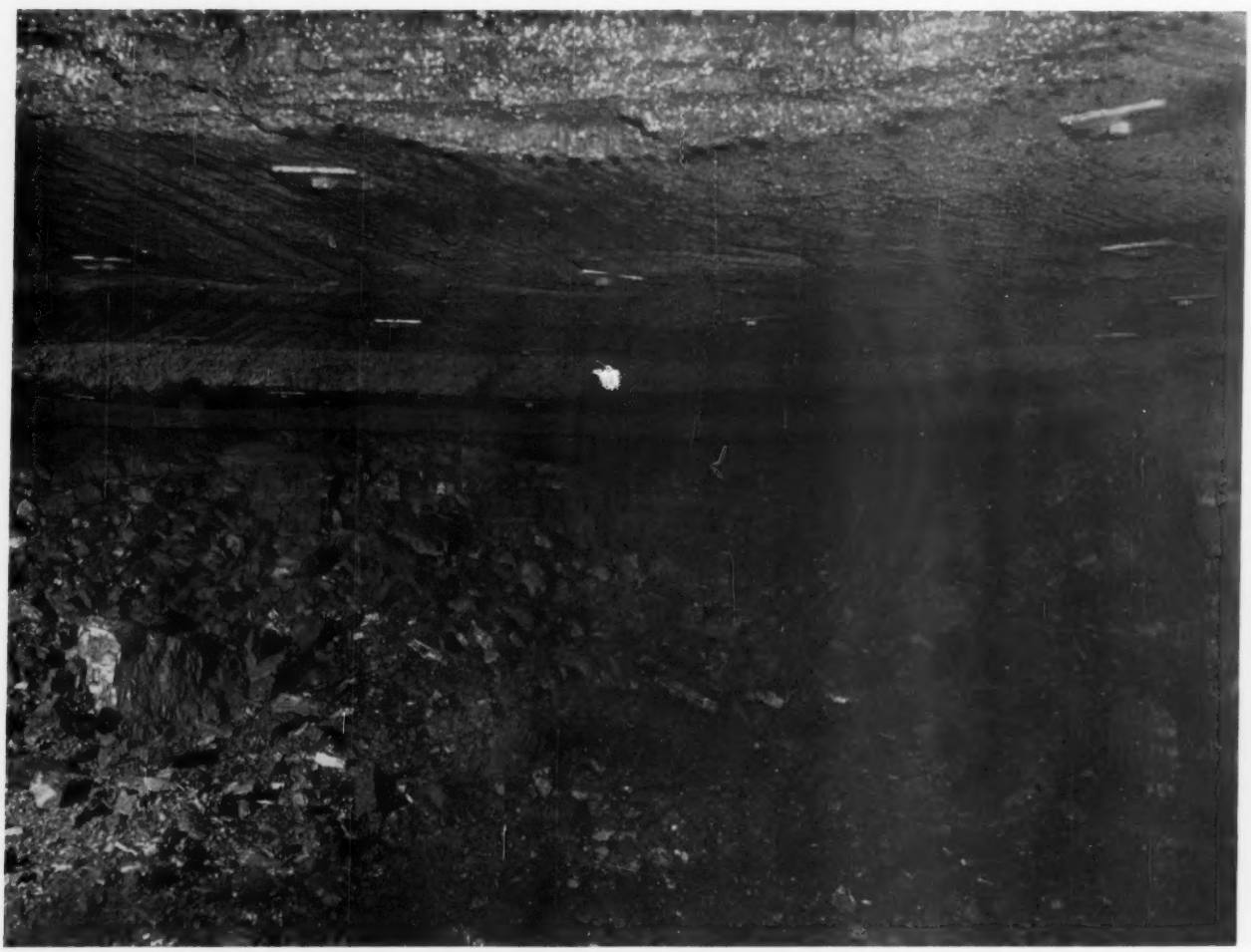
vary too much from an established mining pattern.

In preparing a face for blasting, the coal is first cut near the top to a depth of 9 ft., using a Jeffrey 29-U rubber-mounted cutting machine. The cut, extending from rib to rib, usually leaves 12 in. of top coal for immediate roof support. A vertical, or shear, cut, also 9 ft. in depth, is made at the center of the face. The roof is drilled for pinning with Joy SS-10 stopers. The roof bolts, 5½ ft. long with expansion shells, are set in a definite pattern on 4-ft. centers.

Drilling and Blasting

The method of breaking down the coal in the Black Diamond mines starts with the use of Jeffrey A-9A 9-ft. hydraulic drills equipped with Kenna-

LOADING BLASTED COAL: Following blasting operations, the broken coal is loaded out from a face in the mine by the operation of Joy 14-BU loaders and deposited into Joy 5-SC shuttle cars.

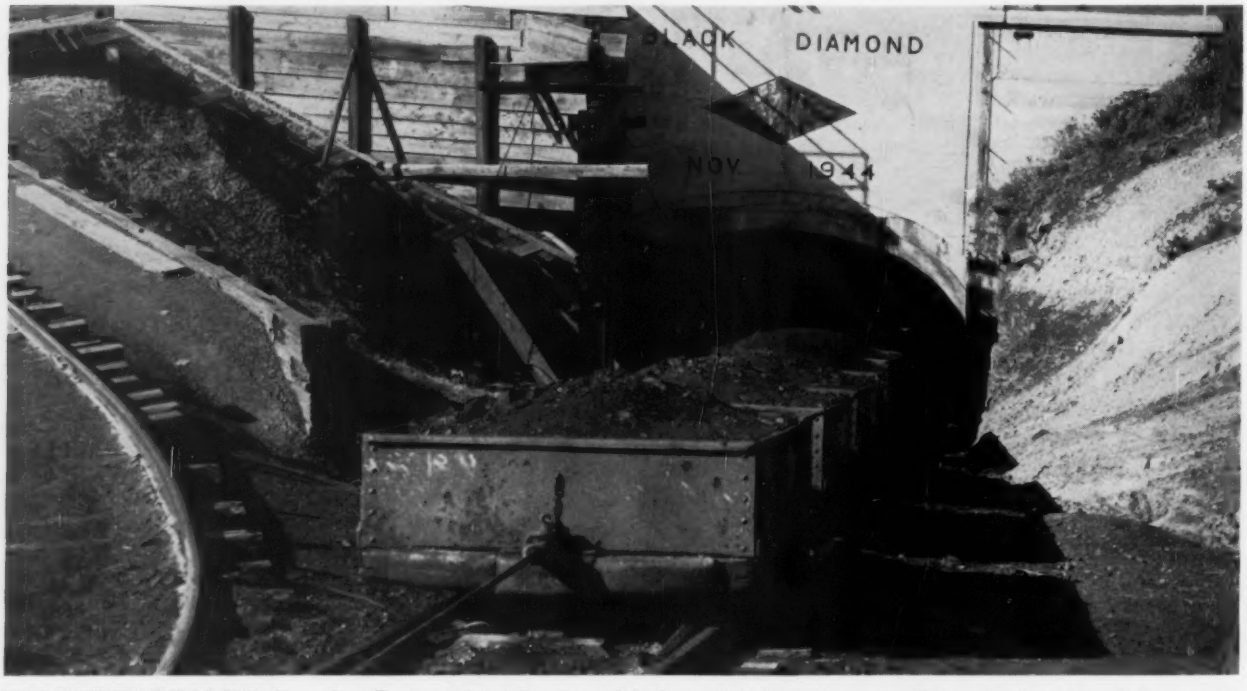


AFTER BLASTING: An average blast of Hercules Red H A permissible powder in a full-width room produces about 80 tons of broken coal, representing approximately 8 to 10 tons of coal per pound of explosives used. The mine is non-gassy.

DUMPING INTO CARS: At a ramp on the heading, the coal in the shuttle cars is dumped into Sanford-Day 3-ton mine cars for tramming by electric locomotives to a sidetrack at the foot of No. 2 Slope.

metal augers and bits, style D 1⅞, to drill 12 to 14 holes into the working faces. The holes are 1½ in. in diameter, 9 ft. deep, with 4 by 6-ft. spacings. The spacings, greater than usual, are possible because of the shear cut at the center of each coal face. Each hole is loaded with one 1¼ by 24-in. King-Size cartridge of Red H® A permissible powder primed with a Hercules® Electric Blasting Cap. After the explosives charges are loaded, the holes are tamped to their collars with rock dust. The leg wires of the caps are connected in series and blasts are fired with a Femco battery. The average blast in a full-width room produces about 80 tons of broken coal, representing approximately 8 to 10 tons per pound of explosives. The mine is non-gassy.

After blasting, the coal is loaded out



EN ROUTE TO THE PLANT: From the collecting point at the center of the basin, eight loaded cars are pulled up the slope through the concrete portal to the surface and on to the preparation plant.

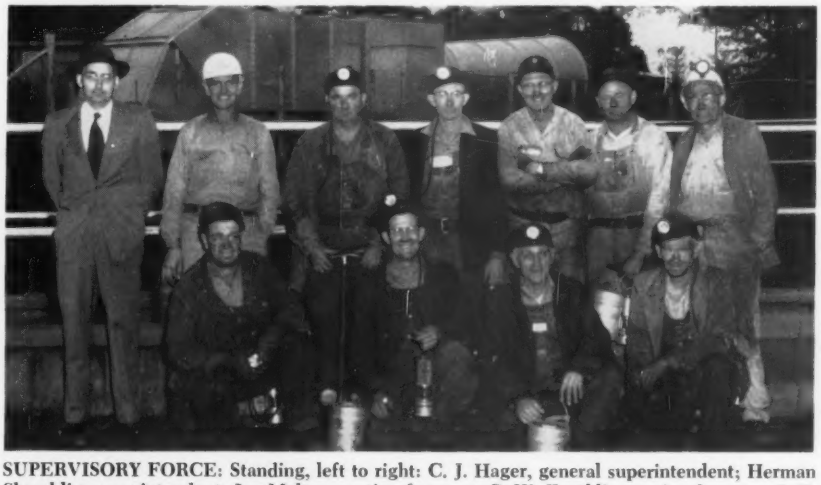
THE PREPARATION PLANT: At the tipple, two cars are dumped at a time by an electrically operated revolving dump unit into a 50-ton bin from where it is fed onto a conveyor for delivery to the preparation plant.

from the face by the operation of Joy 14-BU loaders and deposited into Joy 5-SC shuttle cars. The loaded cars are transported to a ramp on the heading where the coal is dumped into 3-ton steel mine cars. The mine cars are then spotted at the ramp by remote-controlled hoists. From the ramp, 6-ton, reel-type Jeffrey and 10-ton General Electric locomotives tram the loaded cars to the main sidetrack located at the foot of No. 2 Slope. From the collecting point, which is at the center of the basin, eight cars are pulled up the slope to the surface and on to the preparation plant. The power for the hoisting operations is supplied by a 600-hp. hoist located about 750 ft. from the portal.

Upon arrival at the tipple, the loaded cars are weighed on a Streeter-Amet automatic scale and dumped, two cars at a time, by an electrically operated revolving dump into a 50-ton bin. The coal is then fed from this bin by a reciprocating feeder onto a pan and belt conveyor to the preparation plant.

The first step in the preparation cycle consists of discharging the coal as it comes from the mine onto a vibrating scalping screen with 3-in. perforations. All of the minus 3-in. coal is dropped onto a 30-in. conveyor belt. The top sizes pass over a 42-in. picking belt, and the rock is removed by hand. The plus 3-in. coal is discharged into a Jeffrey single-roll crusher that reduces it to 3 by 0-in. size. From the crusher, it is discharged onto a 30-in. belt which carries it, along with the minus 3-in. coal from the scalping screen, to two Allis-Chalmers vibrating screens where the coal is separated into desired sizes and stored in 50-ton steel bins. The final operation in the preparation process consists of jigs and concentrating tables where it is washed and loaded into railroad cars for shipment to customers.

The officials and supervisory personnel in the Black Diamond Coal Mining Company include Charles S. Blair, president and general manager; Robert J. Blair, vice president in charge of operations; Mrs. Charles S. Blair, treasurer; John C. Sherman, secretary and purchasing agent; Charles J. Hager, general superintendent; and I. W. Miller, chief engineer.



SUPERVISORY FORCE: Standing, left to right: C. J. Hager, general superintendent; Herman Shamblin, superintendent; Joe Melton, section foreman; C. W. Franklin, section foreman; J. E. Cain, chief electrician and master mechanic; S. R. Franklin, section foreman; L. T. Byrum, mine foreman. Kneeling, left to right: C. C. Moore, section foreman; Johnnie Rice, section foreman; C. I. (Pop) Bennett, night foreman; and Frank Smith, section foreman.

EXPLOSIVES CUT COST OF RAZING SMOKESTACKS

Controlled blasting removes two towering concrete structures economically, in record time, and without damage to abutting property

J. J. O'NEILL*

AFTER nearly 50 years of service to the community of Williamsport, Pennsylvania, two towering smokestacks at the Hepburn Street generating plant of Pennsylvania Power and Light Company are no longer traditional landmarks. The skillful use of industrial explosives and blasting methods made possible the quick and economical removal of these obsolete chimneys.

Continuous technological improvements in the public utility field have made it more economical and efficient to supply whole areas with electric power from a central generating plant than by the former method of serving each community from its own individual unit. With the recent construction of a big, modern generating plant at nearby Sunbury, which will serve Williamsport and many other adjoining areas, the facilities of the Hepburn Street plant are no longer needed. Because of this, the officials of Pennsylvania Power and Light Company decided to raze the latter plant and to provide more space for much needed storage and parking areas.

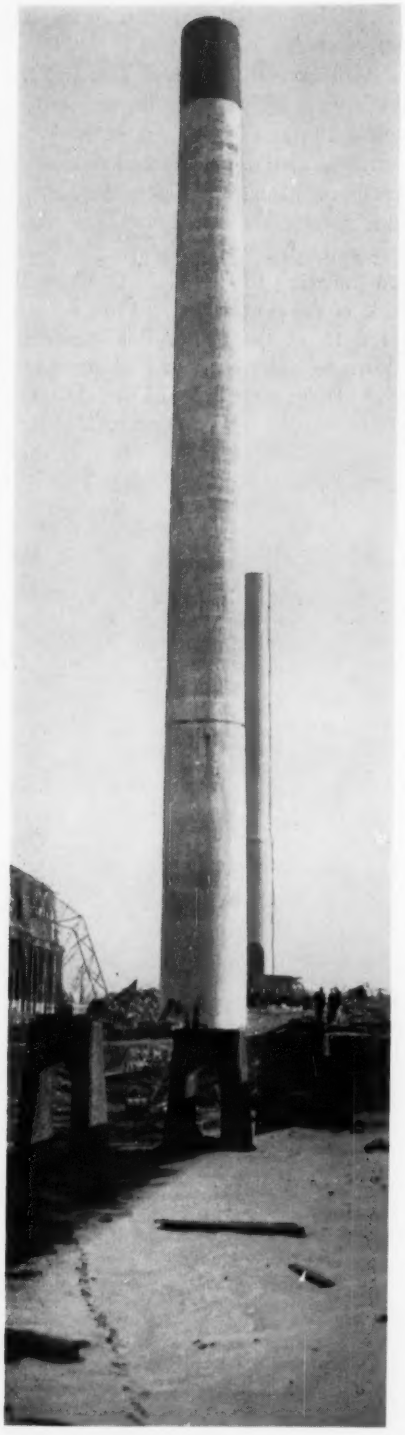
Lipsett, Inc., of New York City, with a notable record in demolition and salvage work, was selected to do the job of razing the plant, including the two smokestacks – one 232 ft. high and the other 176 ft. high. The Lipsett record includes such outstanding jobs as the salvaging of the French liner Normandie, and the demolition of the Kulpmont and Lykens plants for Pennsylvania Power and Light Company. This organization is also prominently identified with the heavy-construction field; it recently completed the construction of the Lehigh Tunnel on the northeast extension of the Pennsylvania Turnpike.

*Hercules Powder Company
Wilmington 99, Delaware

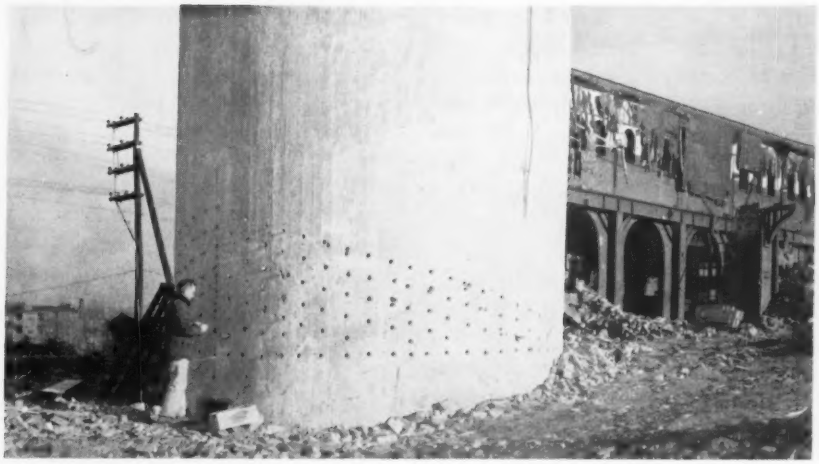
Removing Stacks Poses Problems

The razing of the generating plant itself posed no problems; the usual drop ball and torch methods were used and the work of demolition proceeded according to schedule. The removal of the two smokestacks presented a different and more difficult problem. It was estimated that $10,000 would be spent for labor, in the erection and dismantling of the necessary scaffolding, and the transportation of broken material to locations on the property site requiring fill. It was finally decided to remove the stacks by blasting, and explosives engineers were consulted.

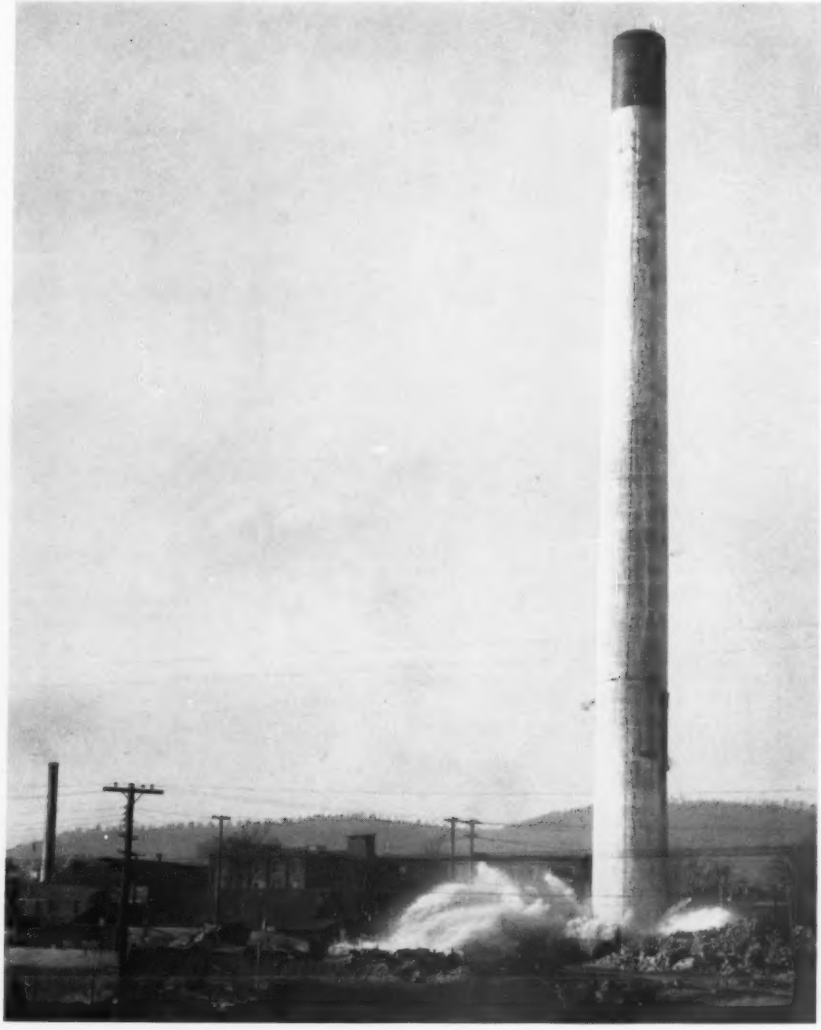
Paul Major, engineer for Pennsylvania Power and Light Company, and Charles Andreshonis, superintendent for Lipsett, accompanied by the explosives engineers, looked over the situation and made a survey to determine where the stacks should fall. The principal considerations were to determine



TWO TOWERING SMOKESTACKS: In razing the Hepburn Street generating plant in Williamsport, Pennsylvania, these two huge smokestacks had to be removed. Investigation developed that the job could be done quickly and economically with explosives.



BLASTING PREPARATIONS: Starting 20 ft. from the center line of Stack No. 1, a series of blast holes were drilled around the 58-ft. circumference of the reinforced-concrete structure.



CHARGES DETONATED: The photographer took this picture at the moment of detonation of the dynamite charges in the drill holes in the base of the stack.

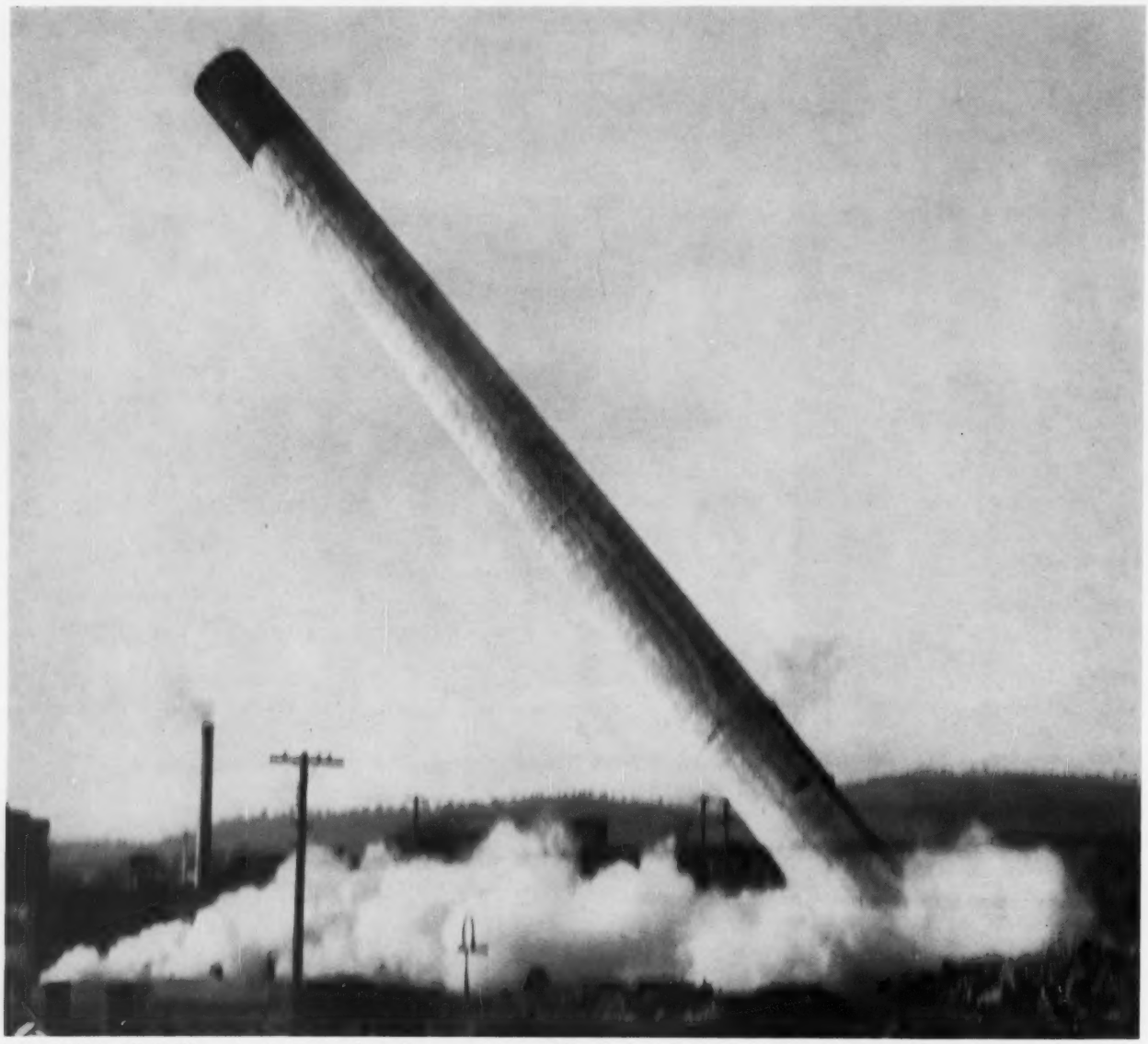
how to avoid damage to surrounding structures, to make the required fill, and to have a minimum amount of cleaning-up operations. After agreement was reached, center lines were made on both stacks to indicate the direction of the fall, and a drilling and blasting procedure was designed to attain the objectives.

Because the stacks were built so long ago, one in 1907 and the other in 1918, by the Weber-Weber Chimney Company, no accurate blue prints were available to show construction details. Test holes had to be drilled to determine the nature of the material and the construction of each stack. Stack No. 1 was 232 ft. high, with an outside circumference of 58 ft. at the base. The test holes revealed that this stack was built of steel-reinforced concrete 17½ in. thick at the base. Stack No. 2 was 176 ft. high and had an outside circumference of 39 ft. at the base. It was constructed of reinforced concrete with a tile liner which was separated from the concrete by a 2-in. air space. The reinforced concrete was 9½ in. thick, plus an air space and the tile brick liner.

Drilling and Blasting

The overall drilling and blasting pattern for both stacks was essentially the same. A description of this phase of the job is confined to work done on the larger stack.

As indicated, this stack was 232 ft. high with a 58-ft. outside circumference. It was 17½ in. thick at the base and was made of reinforced-steel concrete construction. Using the center line established by the power company's engineer, a wedge was laid out on the stack to extend 20 ft. on each side of the center line and to a height of 6 ft. at the center line, tapering down to meet each end of the base line. Holes were drilled 15 in. deep on 10-in. centers. This made a total of 224 holes drilled into Stack No. 1, plus 5 burn holes (drilled through). The line



HALFWAY DOWN: This is Stack No. 1 at the halfway point in its fall to the ground after the explosives had done their work in the base of the structure. The blast comprised 156 drill holes, each loaded with Hercules Extra Dynamite 60% strength.

EXACTLY AS PLANNED: Here are the shattered pieces of the once huge concrete landmark after it had landed and was broken on the ground exactly as planned. No damage was done to surrounding property.

of holes at the base extended approximately two-thirds of the circumference of the stack.

Considering the uncertain strength of the construction and the advisability of testing the explosives charges, preliminary blasts were fired in the stack. The first such blast included 68 holes, each loaded with one 1¼ by 8-in. cartridge of Hercules® Extra Dynamite 60% and primed with short-period delay electric blasting caps from No. 1 to No. 6, connected in series-in-parallel. Each charge was stemmed with extruded clay tamped to the hole collar. This blast produced an opening approximately 16 ft. high and 7 ft. wide. The results indicated that the engineers' estimate of the stack's construction and the amount of dynamite used was correct.

The final blast consisted of firing charges in the remaining 156 holes, using the same loading factor and firing procedure as the preliminary blast. Short-period delays, No. 1 to No. 10, were used as primers to detonate the charges.

The only significant difference in the drilling and blasting procedure was brought about by the smaller dimensions of Stack No. 2. Only 176 drill holes were needed in this stack plus 5 burn holes on the center line. Each hole was loaded with ½ cartridge of Hercules Extra Dynamite 60%. Because of the proximity of some substations and power lines, one side of this stack was barricaded to a height of 6 ft. with burlap bags filled with sand. This effectively prevented any debris flying in that direction.

Both stacks fell exactly as planned, and no damage was done to surrounding property.

WARNER'S BELL MINE

Wins Another Safety Award

Limestone mine at Bellefonte, Pennsylvania, wins first place in the National Crushed Stone Association's annual safety contest for the second consecutive year

One of the highlights of the recent annual meeting of the National Crushed Stone Association in Miami Beach, Florida, January 15 through 17, was the award of THE EXPLOSIVES ENGINEER plaque to Warner Company's Bell Mine, Bellefonte, Pennsylvania, for the best safety record among 73 competing member operations during 1955. The winning record was 264,075 man-hours of work without a lost-time injury.

The award was made at the Greeting Luncheon by H. H. Kirwin, chairman of the Accident Prevention Committee of the Association, to W. M. Smith, general mine foreman of Bell Mine. The award was particularly noteworthy because it was the second consecutive time that this property has won first place in the annual NCSA safety competition.

Twenty-nine other member plants also achieved perfect safety records throughout the year and were awarded engrossed Certificates of Honorable Mention. They are listed below.

CERTIFICATE WINNERS

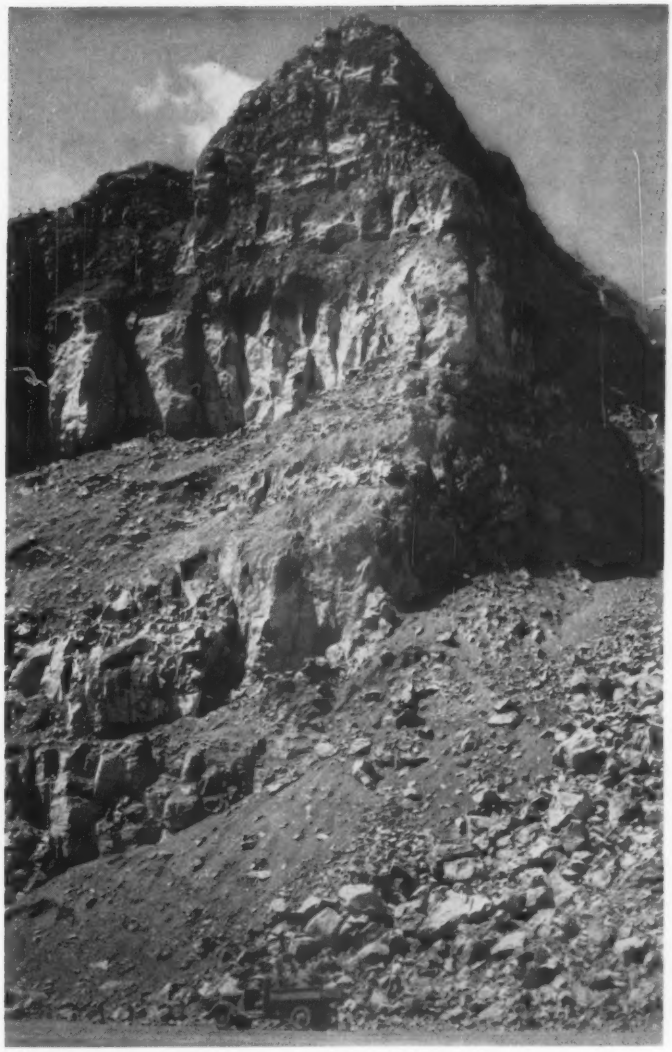
FIGURES REPRESENT NUMBER OF ACCIDENT-FREE MAN-HOURS WORKED

Bessemer Quarry Bessemer Limestone and Cement Company Bessemer, Pennsylvania	229,230
Quarry No. 3 Columbia Quarry Company Valmeyer, Illinois	227,587
Glen Mills Quarry General Crushed Stone Company Glen Mills, Pennsylvania	222,987
Krause Quarry No. 1 Columbia Quarry Company Columbia, Illinois	187,216
Security Quarry North American Cement Corporation Hagerstown, Maryland	180,140
Cheektowaga Quarry Federal Crushed Stone Corporation Cheektowaga, New York	140,065
Kimballton Mine Standard Lime & Cement Company Kimballton, Virginia	120,142
Plant No. 1 Quarry Callanan Road Improvement Company South Bethlehem, New York	116,325
White Haven Quarry General Crushed Stone Company White Haven, Pennsylvania	114,800
Jamestown Quarry Superior Stone Company Jamestown, North Carolina	101,953
Belgrade Quarry Superior Stone Company Maysville, North Carolina	94,644
Ives Quarry Consumers Company Racine, Wisconsin	91,159
Bakerton Mine Standard Lime & Cement Company Bakerton, West Virginia	83,439
Cedar Hollow Quarry Warner Company Devault, Pennsylvania	76,608
Martinsburg Quarry Standard Lime & Cement Company Martinsburg, West Virginia	69,044
Plant No. 1 Quarry New Haven Trap Rock Company Wallingford, Connecticut	63,924
Bakers Quarry Superior Stone Company Monroe, North Carolina	62,682
Yellow Rock Mine Kentucky Stone Company Yellow Rock, Kentucky	60,667
Bonne Terre Quarry Valley Dolomite Corporation Bonne Terre, Missouri	60,320
Plant No. 4 Quarry New Haven Trap Rock Company Plainville, Connecticut	52,201
Union Furnace Quarry Warner Company Tyrone, Pennsylvania	41,905
Prospect Stone Plant No. 6 Eastern Rock Products, Incorporated Prospect, New York	37,328
Cape Girardeau Mine Federal Materials Company Cape Girardeau, Missouri	36,000
Stafford Quarry Genesee Stone Products Corporation Stafford, New York	34,176
Avoca Quarry Jefferson County Stone Company Avoca, Kentucky	27,104
Boonesboro Mine Kentucky Stone Company Richmond, Kentucky	21,914
Mine No. 7 Columbia Quarry Company Elsberry, Missouri	18,088
Randville Quarry Superior Rock Products Company Sagola, Michigan	16,184
Plant No. 4 Quarry Southwest Stone Company Knippa, Texas	14,403

QUARRYING BASALT IN HAWAII

Efficient and economical operations are maintained in a hard-rock quarry with a 350-ft.-high face

STERLING R. MARCHER*



THE QUARRY FACE: Because of the great height of the quarry face, the basalt formation is blasted by the coyote, or tunnel, method in two sections: one at the quarry floor and the other at a point about 210 ft. above the floor.

BASALT, a dense blue-gray to black igneous rock, is most generally used by contractors in the Hawaiian Islands because of its ready availability, and quarries producing crushed basalt can usually be found on most of the islands. One of the better-known basalt quarries on the island of Oahu in the Hawaiian group is operated by Hawaiian Rock and Supply Company, Ltd., a subsidiary of Hawaiian Dredging Company of Honolulu. The quarry, located about 90 ft. above sea level and about one-half mile from the ocean at Kaena Point on the western tip of the island, was opened in September, 1933.

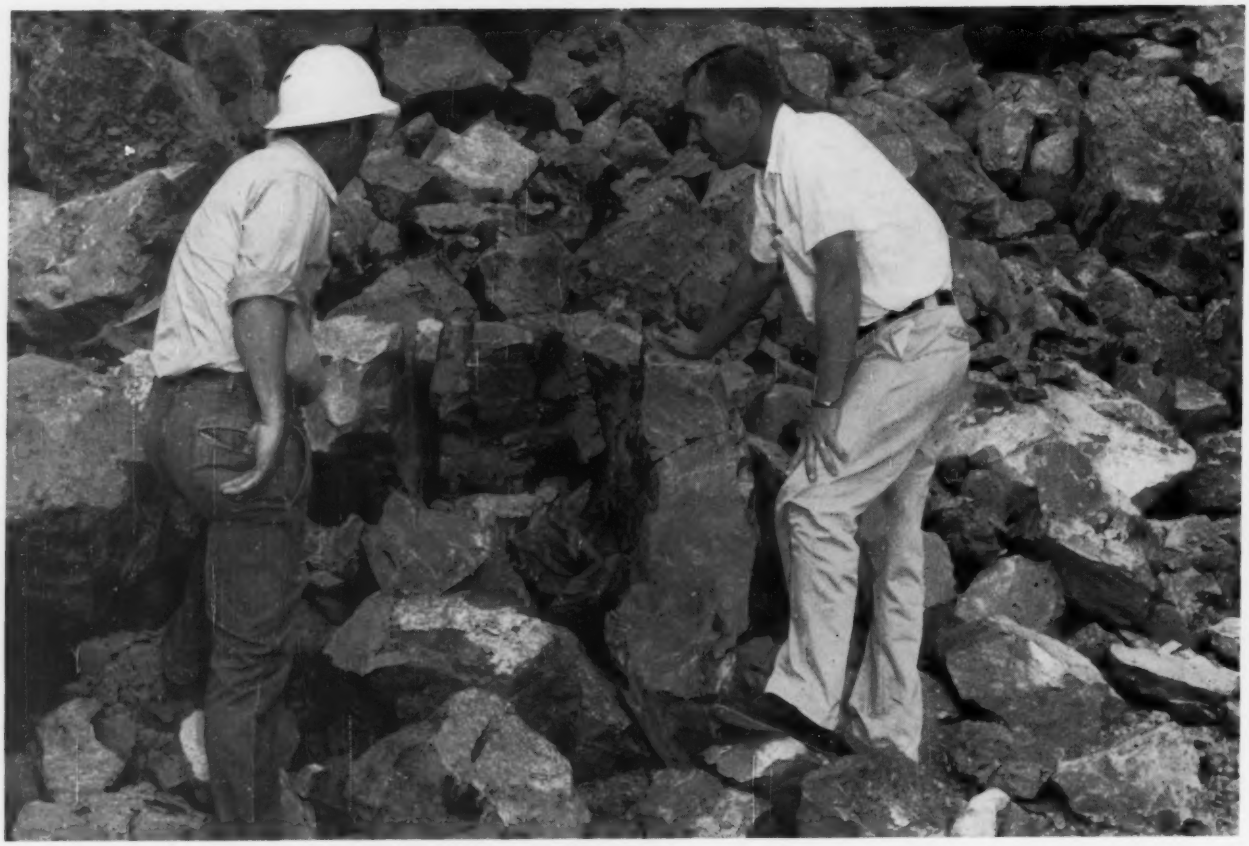
At present, operations in the quarry are confined to one high point of rock which juts out of a rather precipitous range of hills. Starting at the quarry floor is a 90-ft. stratum of gray basalt topped with a 2 to 3-ft. layer of volcanic ash. Overlying this is a stratum of blue-gray basalt 150 ft. thick. On top of this is a stratum of red ash 2 to 3 ft. thick which, in turn, is overlain by about 120 ft. of mixed basalt and cinder material.

The basalt at this quarry has a specific gravity of 2.9 and weighs about 180 lb. per cu. ft. in the solid. Because of the great height of the quarry face, approximately 350 ft. above the floor at its highest point, the company management concluded that the most efficient and economical means of blasting the rock is by the coyote, or tunnel, method. The face is blasted in two lifts or sections; after the broken rock from a tunnel blast made at the quarry floor level is removed, a second tunnel, roughly 210 ft. above the quarry floor, is blasted.

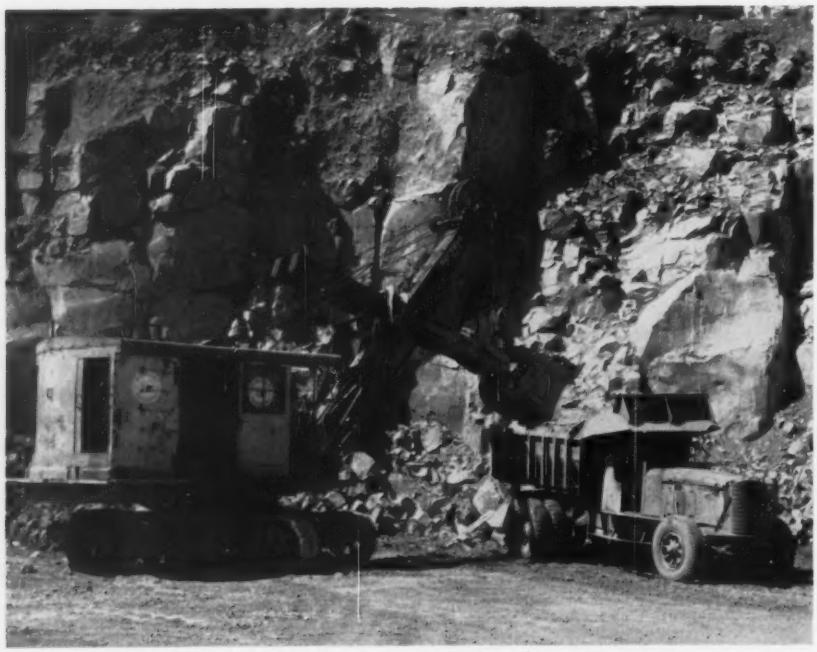
Typical Tunnel Blast

In a typical tunnel blast made at the quarry floor, a horizontal tunnel 3 ft. wide by 5 ft. high is driven into

*2113 S. Longwood Avenue
Los Angeles 16, California



EXCELLENT ROCK BREAKAGE: A close-up of the rock fragmentation after a tunnel blast and some secondary blasts had been fired. Examining the results are Mike Shizuru, left, quarry superintendent, and C. E. Bedell, field representative of Gray, Cheeley & Graham, distributors of Hercules Powder Company's explosives and blasting supplies.



SHOVEL OPERATIONS: A 37-B Bucyrus-Erie shovel with a 1¾-cu. yd. dipper is used to load blasted basalt into a 20-ton Autocar equipped with a dual telescopic hoist and rock body.

the rock at right angles to the quarry face for a distance of about 45 ft. At the end of this tunnel, referred to as the stem, two tunnels known as wings, each 45 ft. in length, are driven at right angles to the stem, forming a large T. These small-dimension tunnels are driven with light drifter drills. Each blast, or round, consisting of seven holes, usually pulls 4 ft. of advance. The explosives in each round, Gelamite® 2 packed into 1¼ by 8-in. cartridges, are detonated by delay electric blasting caps, first through fourth periods of delay.

The charges of dynamite used to blast the tunnel are placed at equidistant points in the two wings of the tunnel, never in the stem. The locations of these dynamite charges are called pockets. All pockets are connected with two lines of Plastic-Reinforced Primacord,* the detonating

*Reg. U. S. Pat. Off.
by The Ensign-Bickford Company

BIRD'S-EYE VIEW: This view from a location halfway up the quarry face includes the crushing plant at right, the asphalt plant at left, and the Pacific Ocean in the background. The company processes about 150,000 net tons of crushed basalt each year.

medium used to blast all the charges simultaneously. The intervening space between the pockets is filled or stemmed completely with rock fragments and rock sand. The stemming material is extended throughout the stem to the portal of the tunnel.

In making a tunnel blast in the upper section of the face, a tunnel is driven from one end of the face and parallel to it for a distance of about 140 ft. A burden of about 45 ft. is maintained between the tunnel and the quarry face. In making these tunnel blasts, an average of 13,100 lb. of Hercomite® Bag, packed in 4-in. by 12½-lb. bags, and 600 lb. of Gelamite 2 in 2 by 8-in. cartridges is used per blast. The amount of explosives loaded varies with the tonnage of rock overlying the tunnel and the amount of rock burden between the tunnel and the face of quarry. Two 50-lb. cases of Gelamite 2 are used as primers in each

ABOVE THE CRUSHING PLANT: A truck loaded with broken rock from the quarry dumps its contents onto the quarry floor close to the hopper of the rock bin chute above the crushing plant.

INTO THE HOPPER: A Caterpillar D-8 tractor pushes the blasted basalt into the hopper of the rock bin from where it goes by means of gravity to the plant for final crushing and screening operations.

pocket, and Primacord lines are securely half-hitched and taped to these primer cartridges.

Tunnel blasts are fired by a Hercules 50-cap blasting machine with one Hercules® 6-ft. Electric Blasting Cap taped to each of the two Primacord lines extending from the portal of the tunnel. These blasts are made at the quarry about every three to four months depending upon the demands for crushed stone in the local market. Mike Shizuru, quarry superintendent, estimates that an average of 90,000 tons of broken basalt is brought down per tunnel blast. The explosives loading ratio averages ¾ lb. of dynamite per cu. yd. of rock in the solid.

The few large boulders from the blasts are broken by mudcapping, using a maximum of 3 lb. of 2 by 8-in. cartridges of Gelamite 2 per boulder. These charges are primed with Black Sequoia Safety Fuse and Hercules No. 6 Blasting Caps. This method of secondary blasting results in excellent fragmentation. Because of the extreme hardness of the rock, it is more economical than blasting by the block-hole method of secondary reduction.

Snake-Hole Blasting

Occasionally, it is necessary to do some drilling and blasting at the quarry floor, particularly at the sides of the quarry face where the rock tapers down and is too far away from a tunnel blast to be affected by it. In these instances, two rows of holes, called snake holes, are drilled into the toe of the quarry face. The bottom row of holes is spaced 7 ft. apart and the upper row is drilled 8 ft. above and centered between the bottom holes. The bottom and upper holes are 24 ft. in depth, and slanted slightly downward and upward respectively. An Ingersoll-Rand X-71 wagon drill and an X-71 drifter are used to drill these holes, utilizing Ingersoll-Rand drill steel and Carset bits. Air is supplied to the drills by a Sullivan WK-60, 210-c.f.m. air compressor. Each snake hole is loaded with 50 lb. of Gelamite 2 in 2 by 8-in. cartridges to within 8 ft. of the collar of the hole. The remainder of the hole is stemmed with paper tamping bags filled with rock sand. Either Primacord or Hercules 16-ft. Short-Period Delay Electric Blasting Caps in delay periods from 1 to 10 are used for priming the snake holes. Blasts are fired by a Hercules 50-cap blasting machine.

Both the tunnel and the snake hole blasts cast the broken rock upon the quarry floor far enough away from the high face for safe and easy shovel digging and loading. A Bucyrus-Erie 37-B shovel with a 1¾-cu. yd. dipper is employed to load into one 20-ton Autocar equipped with dual telescopic hoist and rock body. After being loaded, the truck is driven about 100 yd. where it dumps the blasted rock onto the quarry floor at the edge of a rock bin chute above the crushing plant. A Caterpillar D-8 tractor pushes the broken stone into the rock bin. From the bin it goes to the crushing plant by means of gravity for final crushing and screening operations.

Granville Cheeley, general manager of the quarry, reports that Hawaiian Rock and Supply Company, Ltd., processes about 150,000 net tons of basalt rock at its crushing plant each year.

DO'S AND DON'TS
FOR USERS OF EXPLOSIVES

Approved by the Institute of Makers of Explosives, September 30, 1955

THE prevention of accidents in the use of explosives is a result of careful planning and observance of the best known practices. The explosives user must remember that he is dealing with a powerful force and that various devices and methods have been developed to assist him in directing this force. He should realize that this force, if misdirected, may either kill or injure both him and his fellow workers.

All explosives are dangerous and must be handled and used with care either by or under the direction of competent experienced persons. It is the responsibility of all persons who handle explosives to know and to follow all approved safety procedures.

Definitions

The term "explosives" as used herein includes any or all of the following: Dynamite, black blasting powder, pellet powder, blasting caps, electric blasting caps, and detonating fuse.

The term "electric blasting cap" as used herein includes both instantaneous electric blasting caps and all types of delay electric blasting caps.

The term "Primer" as used herein means a cartridge of explosives in combination with a blasting cap or an electric blasting cap.

When transporting explosives

1. DO obey all federal, state, and local laws and regulations.

2. DO see that any vehicle used to transport explosives is in proper working condition and equipped with a tight wooden or non-sparking metal floor with sides and ends high enough to prevent the explosives from falling off. The load in an open-bodied truck should be covered with a waterproof and fire-resistant tarpaulin. Wiring should be fully insulated so as to prevent short circuiting, and at least two fire extinguishers should be carried. The truck should be plainly marked so as to give adequate warning to the public of the nature of the cargo.

3. DON'T permit metal, except approved metal truck bodies, to contact cases of explosives. Metal, flammable, or corrosive substances should not be transported with explosives.

4. DON'T allow smoking or unauthorized or unnecessary persons in the vehicle.

5. DO load and unload explosives carefully.

6. DO see that other explosives are separated from blasting caps and/or electric blasting caps where it is permitted to transport them in the same vehicle.

When storing explosives

7. DO store explosives in accordance with federal, state, or local laws and regulations.

8. DO store explosives only in a magazine which is clean, dry, well ventilated, reasonably cool, properly located, substantially constructed, bullet and fire resistant, and securely locked.

9. DON'T store blasting caps, electric blasting caps, or primers in the same box, container, or magazine with other explosives.

10. DON'T store explosives, fuse, or fuse lighters in a wet or damp place, or near oil, gasoline, cleaning solutions or solvents, or near radiators, steam pipes, stoves, or other sources of heat.

11. DON'T store any sparking metal, or sparking metal tools in an explosives magazine.

12. DON'T smoke or have matches, open lights, or other fire or flame in or near an explosives magazine.

13. DON'T allow leaves, grass, brush, or debris to accumulate within 25 feet of an explosives magazine.

14. DON'T shoot into explosives or allow the discharge of firearms in the vicinity of an explosives magazine.

15. DO consult the manufacturer if nitroglycerin from deteriorated explosives has leaked onto the floor of a magazine. The floor should be desensitized by washing thoroughly with an agent approved for that purpose.

When using explosives

16. DON'T use sparking metal tools to open kegs or wooden cases of explosives. Metallic slitters may be used for opening fiberboard cases, provided that the metallic slitter does not come in contact with the metallic fasteners of the case.

17. DON'T smoke or have matches, open lights, or other fire or flame nearby while handling or using explosives.

18. DON'T place explosives where they may be exposed to flame, excessive heat, sparks, or impact.

19. DO replace or close the cover of explosives cases or packages after using.

20. DON'T carry explosives in the pockets of your clothing or elsewhere on your person.

21. DON'T make up primers in a magazine, or near excessive quantities of explosives, or in excess of immediate needs.

22. DON'T insert anything but fuse in the open end of a blasting cap.

23. DON'T strike, tamper with, or attempt to remove or investigate the contents of a blasting cap or an electric blasting cap, or try to pull the wires out of an electric blasting cap.

24. DON'T allow children or unauthorized or unnecessary persons to be present where explosives are being handled or used.

25. DON'T handle, use, or be near explosives during the approach or progress of any electrical storm. All persons should retire to a place of safety.

26. DON'T use explosives or blasting equipment that are obviously deteriorated or damaged.

27. DON'T attempt to reclaim or use fuse, blasting caps, electric blasting caps, or any other explosives that have been water soaked, even if they have dried out. Consult the manufacturer.

When drilling and loading

28. DO carefully examine the face or rock before drilling to determine the possible presence of unfired explosives. Never drill into explosives.

29. DO check the bore hole carefully with a wooden tamping pole or measuring tape to determine its condition before loading.

30. DON'T stack surplus explosives near working areas during loading.

31. DO cut from the spool the line of detonating fuse extending into a bore hole before loading the remainder of the charge.

32. DON'T load a bore hole with explosives after springing (enlarging the hole with explosives) or upon completion of drilling without making certain that it is cool and that it does not contain any hot metal, or burning or smoldering material. Temperatures in excess of 150°F. are dangerous.

33. DON'T spring a bore hole near another hole loaded with explosives.

34. DON'T force cartridges or any explosives into a bore hole or past any obstruction in a bore hole.

35. DON'T force a blasting cap or an electric blasting cap

into dynamite. Insert the cap into a hole made with a punch designed for the purpose.

36. DON'T slit, drop, deform, or abuse the primer.

37. DON'T connect blasting caps, or electric blasting caps to detonating fuse except by methods recommended by the manufacturer.

When tamping

38. DON'T tamp dynamite that has been removed from the cartridge.

39. DON'T tamp with metallic devices of any kind. Use wood tamping tools with no exposed metal parts except non-sparking metal connectors for jointed poles. Avoid violent tamping. Never tamp the primer.

40. DO confine the explosives in the bore hole with sand, earth, clay, or other suitable incombustible stemming material.

41. DON'T kink or injure fuse, or electric blasting cap wires, when tamping.

When shooting electrically

42. DON'T uncoil the wires or use electric blasting caps during dust storms or near any other source of large charges of static electricity.

43. DON'T uncoil the wires or use electric blasting caps in the vicinity of radio-frequency transmitters except at safe distances. Consult the manufacturer or the Institute of Makers of Explosives pamphlet on "Radio Frequency Hazards."

44. DO keep the firing circuit completely insulated from the ground or other conductors such as bare wires, rails, pipes, or other paths of stray currents.

45. DON'T have electric wires or cables of any kind near electric blasting caps or other explosives except at the time and for the purpose of firing the blast.

46. DO test all electric blasting caps, either singly or when connected in a circuit, using only a blasting galvonmeter specifically designed for the purpose.

47. DON'T use in the same circuit either electric blasting caps made by more than one manufacturer, or electric blasting caps of different style or function even if made by the same manufacturer, unless such use is approved by the manufacturer.

48. DON'T attempt to fire a circuit of electric blasting caps with less than the minimum current specified by the manufacturer.

49. DO be sure that all wire ends to be connected are bright and clean.

50. DO keep the electric cap wires or leading wires short circuited until ready to fire.

When shooting with fuse

51. DO handle fuse carefully to avoid damaging the covering. In cold weather warm slightly before using to avoid cracking the waterproofing.

52. DON'T use short fuse. Never use less than two feet. Know the burning speed of the fuse and make sure you have time to reach a place of safety.

53. DON'T cut fuse until you are ready to insert it into a blasting cap. Cut off an inch or two to insure a dry end. Cut fuse squarely across with a clean sharp blade. Seat the fuse lightly against the cap charge and avoid twisting after it is in place.

54. DON'T crimp blasting caps by any means except a cap crimper designed for the purpose. Make certain that the cap is securely crimped to the fuse.

55. DO light fuse with a fuse lighter designed for the purpose. If a match is used the fuse should be slit at the end and the match head held in the slit against the powder core. Then scratch the match head with an abrasive surface to light the fuse.

56. DON'T light fuse until sufficient stemming has been placed over the explosives to prevent sparks or flying match heads from coming into contact with the explosive.

57. DON'T hold explosives in the hands when lighting fuse.

In underground work

58. DO use permissible explosives only in the manner specified by the United States Bureau of Mines.

59. DON'T take excessive quantities of explosives into a mine at any one time.

60. DON'T use black blasting powder or pellet powder with permissible explosives or other dynamite in the same bore hole in a coal mine.

Before and after firing

61. DON'T fire a blast without a positive signal from the one in charge, who has made certain that all surplus explosives are in a safe place, all persons and vehicles are at a safe distance or under sufficient cover, and that adequate warning has been given.

62. DON'T return to the area of any blast until the smoke and fumes from the blast have been dissipated.

63. DON'T attempt to investigate a misfire too soon. Follow recognized rules and regulations, or if no rules or regulations are in effect, wait at least one hour.

64. DON'T drill, bore, or pick out a charge of explosives that has misfired. Misfires should be handled only by or under the direction of a competent and experienced person.

Explosives disposal

65. DON'T abandon any explosives.

66. DO dispose of or destroy explosives in strict accordance with approved methods. Consult the manufacturer or follow the Institute of Makers of Explosives pamphlet on destroying explosives.

67. DON'T leave explosives, empty cartridges, boxes, liners, or other materials used in the packing of explosives lying around where children or unauthorized persons or livestock can get at them.

68. DON'T allow any wood, paper, or fiber materials employed in packing explosives to be burned in a stove, fireplace, or other confined space, or to be used for any purpose. Such materials should be destroyed by burning at an isolated location out of doors and no person should be nearer than 100 feet after the burning has started.

Suggestions for minimizing poisonous gas hazards from use of explosives

1. Use the largest diameter cartridge of explosive that is consistent with the work to be done.

2. Don't use explosives that are obviously deteriorated or damaged.

3. Explosives should not be removed from the cartridges.

4. Do not overcharge.

5. Do not add paper, or other combustible material, to the charge.

6. Avoid all conditions that may cause burning rather than detonation of the explosives.

7. In wet work always use explosives having adequate water resistance and fire the blast as soon after loading as practicable.

8. Confine the charge with incombustible stemming.

9. Provide adequate ventilation and make sure that the air is directed to the working places.

10. Make frequent tests to be sure that the air used for ventilation is free from carbon monoxide or other dangerous gases.

11. Spray the muck pile with water.

12. Allow the maximum practicable time after blasting before returning to the face.

These instructions and warnings are not to be construed as superseding federal, state, corporation or municipal laws, ordinances or regulations. Particular attention is called to the fact that permissible explosives are not permissible unless they are used in the manner specified by the United States Bureau of Mines.

Blasting Rock Under A City Dwelling

A ledge of limestone was blasted and removed from under a home without disturbing the occupants

J. S. ONG*

ONG BLASTING SERVICE of Madison, Wisconsin, received a telephone call in September, 1956, from a local resident, John Foster, to put a basement under his house at 309 Debs Road. Normally, the work involved in excavating a basement under a dwelling isn't considered too difficult. But the Foster basement deviated from the normal.

The house was already built at a location within the city limits. It was set on a concrete footing 2 to 3 ft. deep. Between the floor of the house and the ground there was an 18-in. crawlway. Next came 2 to 3 in. of dirt, followed with 2 ft. of weathered and fractured rock. These materials were removed with a crowbar, a pick, and a shovel. This created a working space of about 3½ ft. from the floor joists and solid rock — Ordovician limestone.

*3432 Sunset Drive
Madison 5, Wisconsin

To do the job, Ong Blasting Service agreed to furnish the required permits to drill and blast, and the equipment, materials, and labor necessary for completion of the blasting operations. Mr. Foster supplied the equipment, tools, and labor required for the mucking operations.

Blasting Procedures

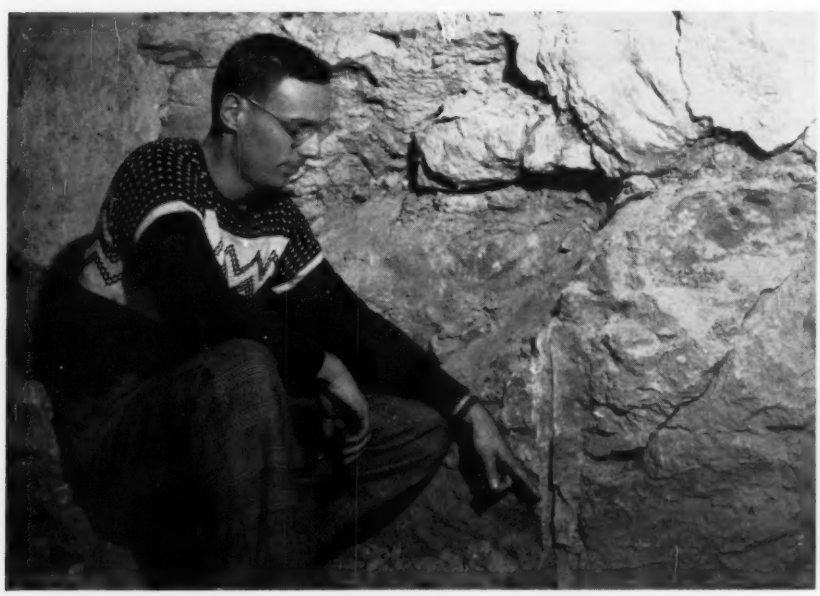
Holes for blasting the Ordovician limestone formation were drilled 4 ft. deep and spaced on a 2 by 2-ft. staggered pattern. The drill used was a 40-lb. Joy sinker drill (dry), powered by a Joy 125-c.f.m. compressor. The drill was equipped with 2- and 4-ft. lengths of drill steel and Timken multi-use detachable rock bits. On the 2-ft. steel, the bits were 1⅞ in.; on the 4-ft. steel, 1⅞ in. Bit life was in excess of 40 ft. each.

A test blast was made in one hole, using a charge of ½ of a 1 by 8-in. cartridge of Hercules® 30% Gelatin Extra. This charge proved to be insufficient. A few more tests were made with increased charges of explosives. Finally, it was determined that loading and firing 1½ cartridges of the 30% Gelatin Extra in a hole produced the desired results.

After all the holes had been drilled, only three or four were loaded with explosives and fired at one time. The charges were primed with short-period delay electric blasting caps, and stemmed to the collars of the holes with a mixture of clay and sand. The cap leg wires were connected in series and blasts were fired with a 50-cap blasting machine.

The Cap-and-Fuse Method

Because of the short depth of the blast holes, 4 ft., and in the interest of economy, it was decided to change the primers from delay electric blasting caps to a combination of No. 6 blasting caps and safety fuse. The fuse was cut into 5-ft. lengths. A cap was crimped to one end of each length of fuse. When ready to blast, the ends of the fuse protruding from the holes were ignited with a hot wire fuse lighter in the order in which the caps were to detonate the dynamite charges.



CONTROLLED BLASTING: The contractor, J. S. Ong, points to the back of a drill hole in the limestone indicating a minimum of overbreak from a blast.

This method produced about one-second delay between the firing of the charges in the holes.

Two old gravel screens, each 3 ft. by 8 ft. by 1-in. mesh, were used as mats to cover each blast. A few junk automobile tires were laid on top of the screens and wired together. This provided a cushion between the gravel screens and the floor joists.

Fragmentation was excellent, except for two 3-ft. boulders which were "block-holed" satisfactorily with ¼ cartridge of the 1 by 8-in. dynamite. The muck was removed by hand and loaded into a slusher that was pulled outside and dumped by tractor. Drilling and blasting required 24 man-hours of work and cost $158. Normal living conditions, necessitating no evacuation, went on inside the house during the blasting. Damage consisted of one broken windowpane and one fallen mirror (unbroken).

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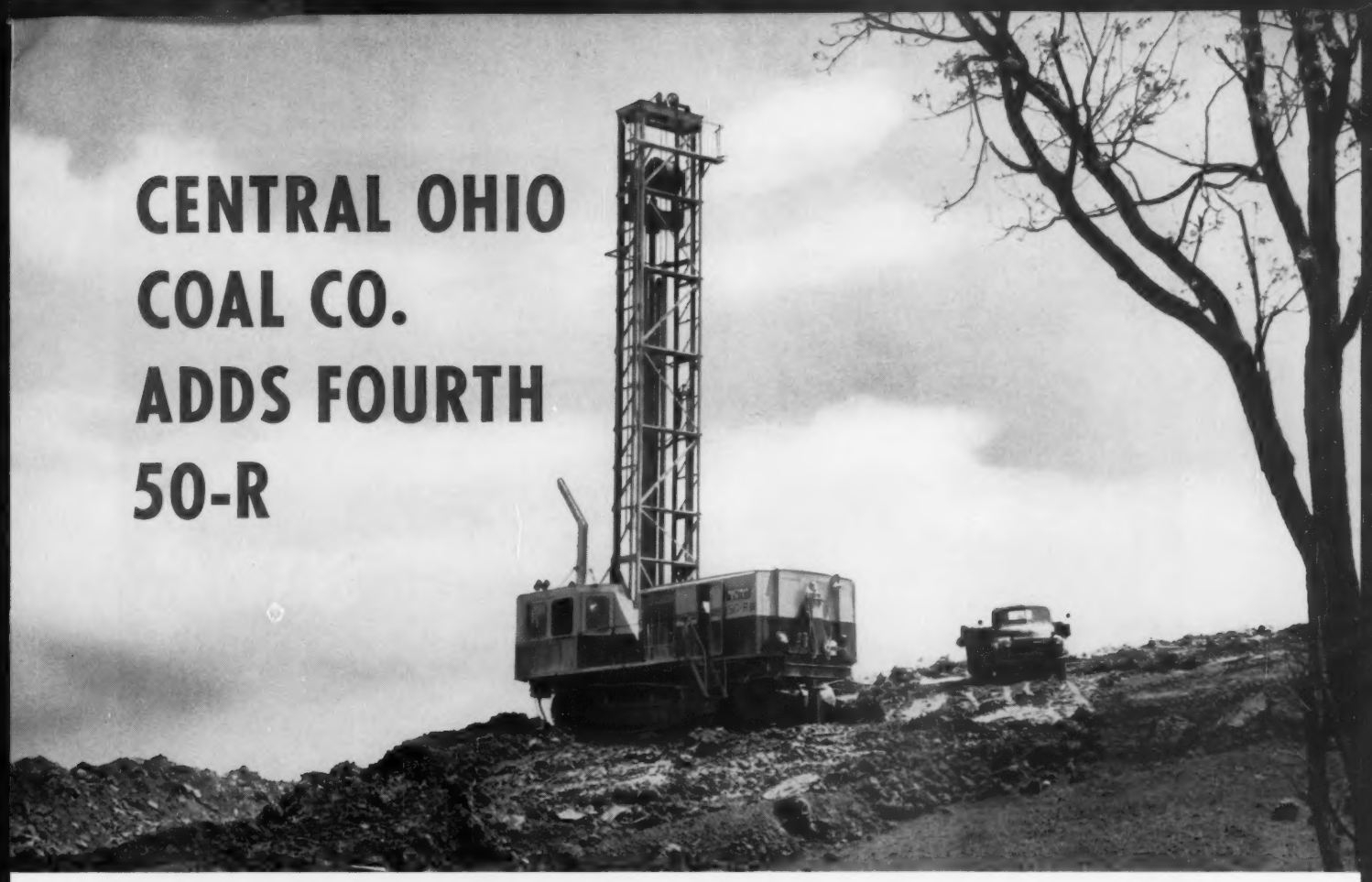

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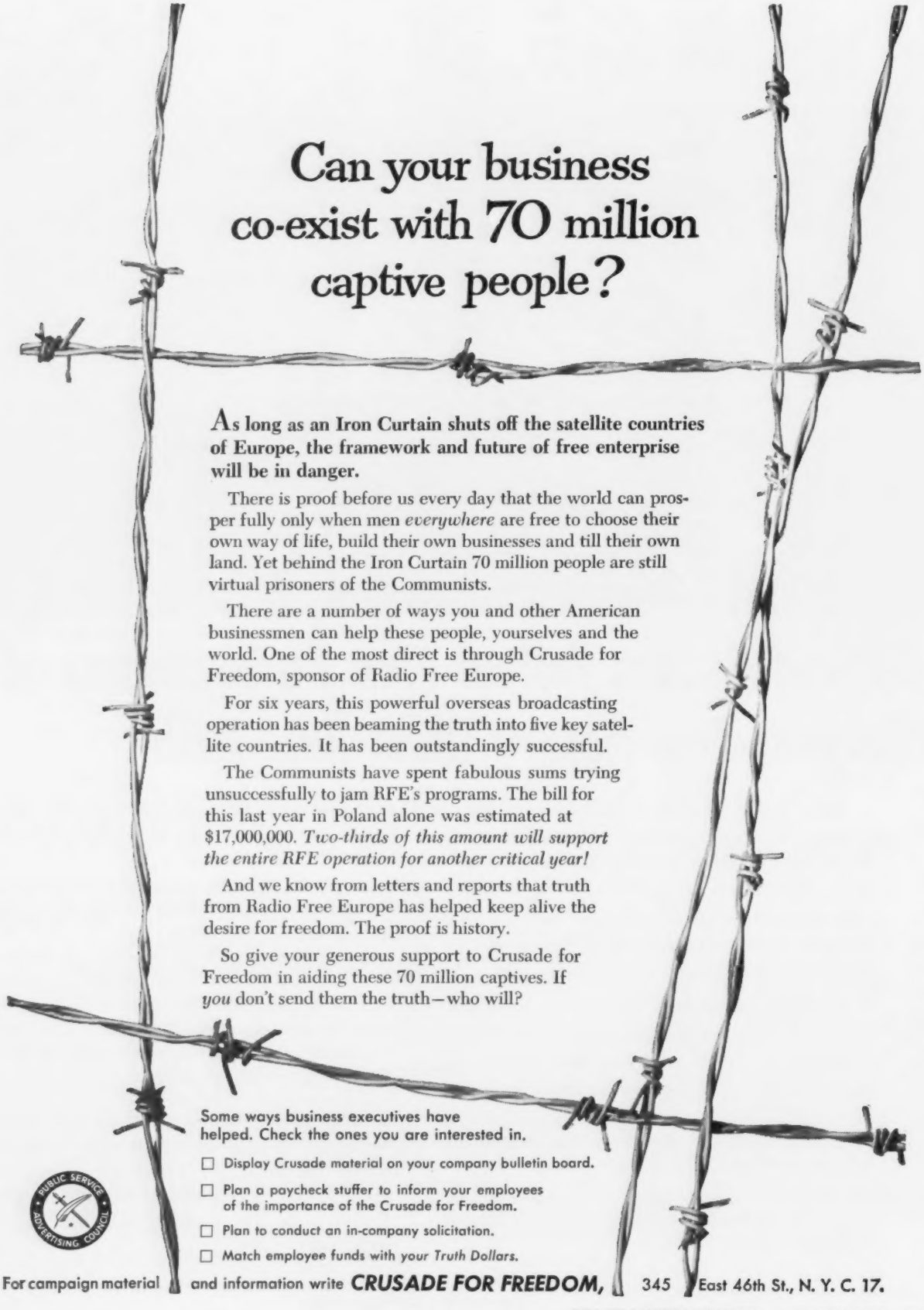

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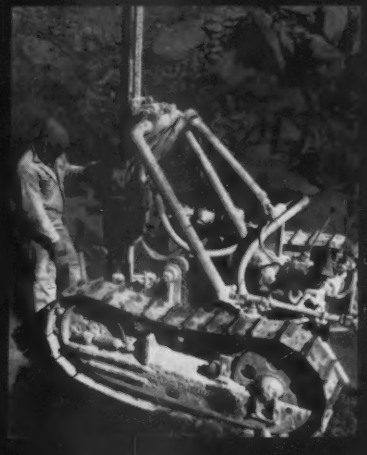

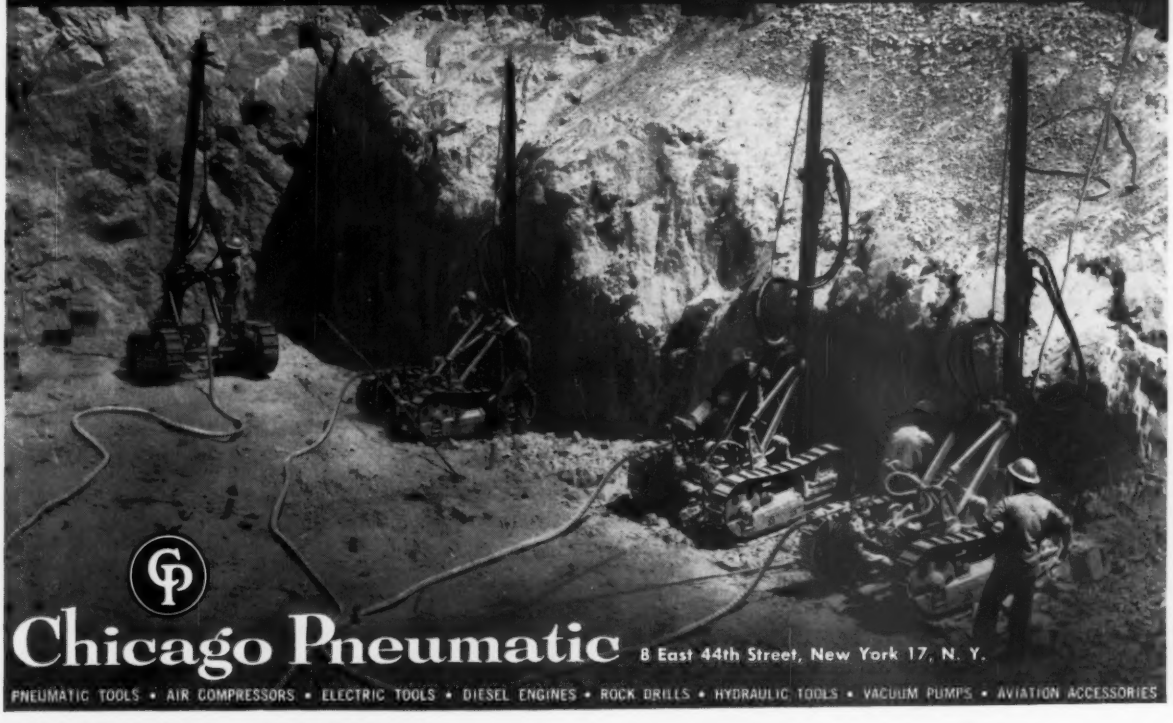

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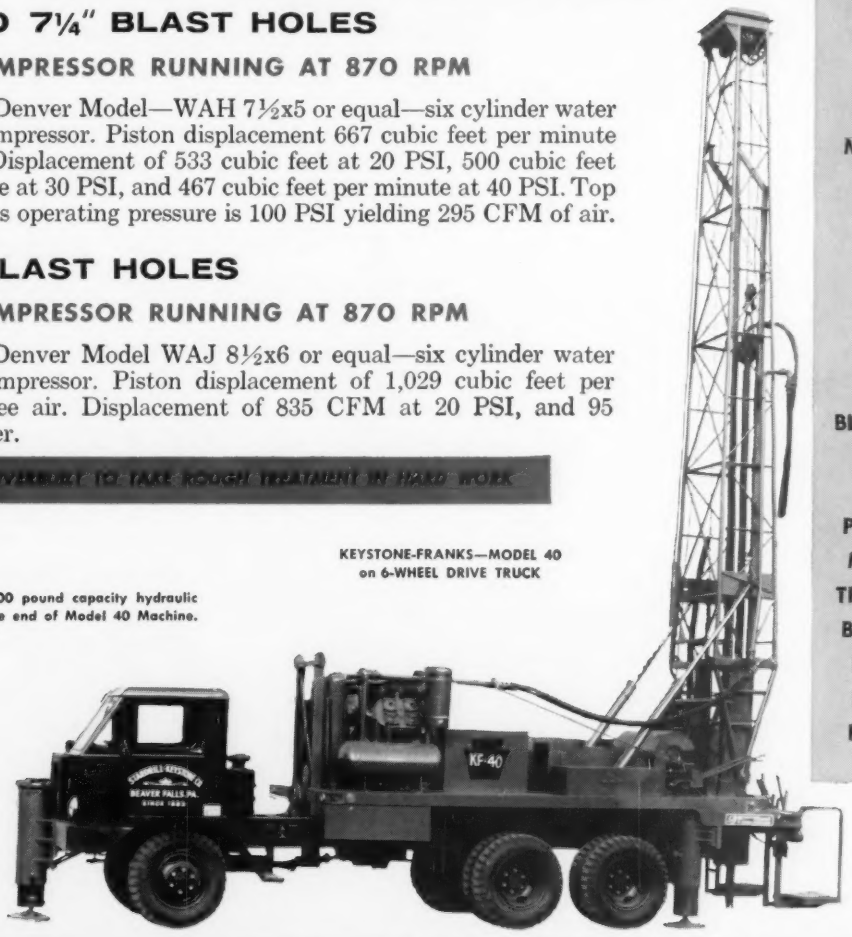

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